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Knappett et al.

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(54) **WOOD CUTTING KNIFE ASSEMBLY PROVIDING IMPROVED KNIFE STABILITY**

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(22) Filed: **Sep. 25, 2003**

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B27C 5/00 (2006.01)

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(58) **Field of Classification Search** 144/241, 144/230, 232, 235, 176, 218, 162.1, 231; 241/92, 93, 296, 298, 294; 407/113, 40, 407/47, 41, 49, 107, 111
See application file for complete search history.

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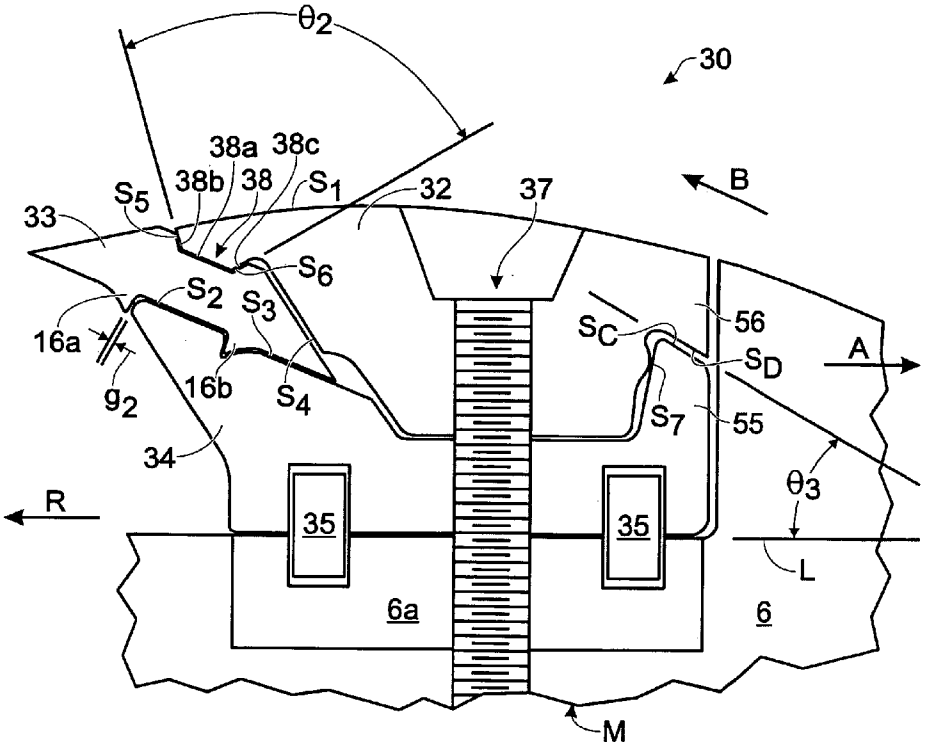
(57) **ABSTRACT**

A wood chipping or cutting knife assembly providing improved knife stability. A number of control surfaces and other geometric features are provided to stabilize the knife in the assembly. An improved splitter is also provided for the knife assembly.

14 Claims, 11 Drawing Sheets



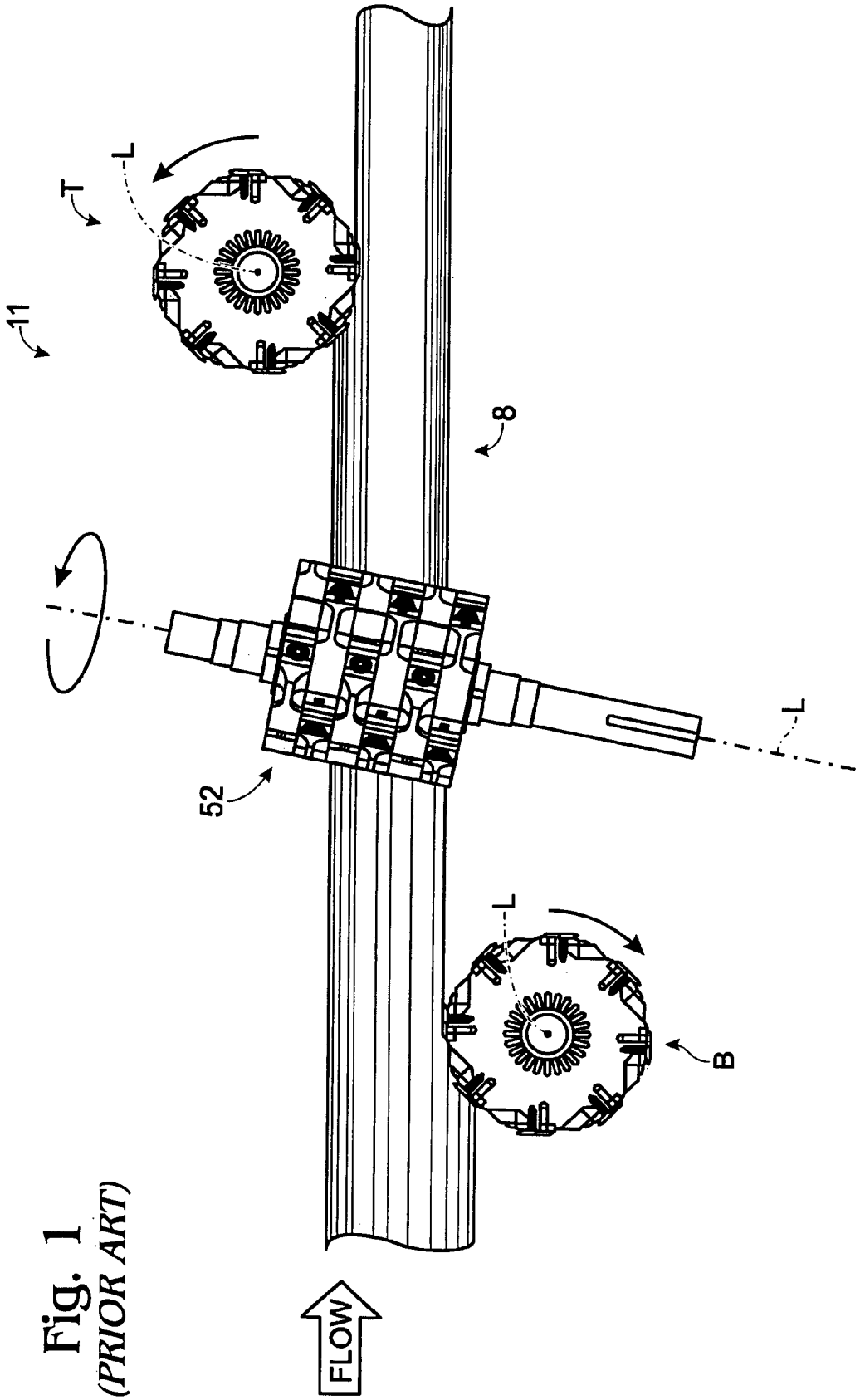


Fig. 1
(PRIOR ART)

Fig. 2A
(PRIOR ART)

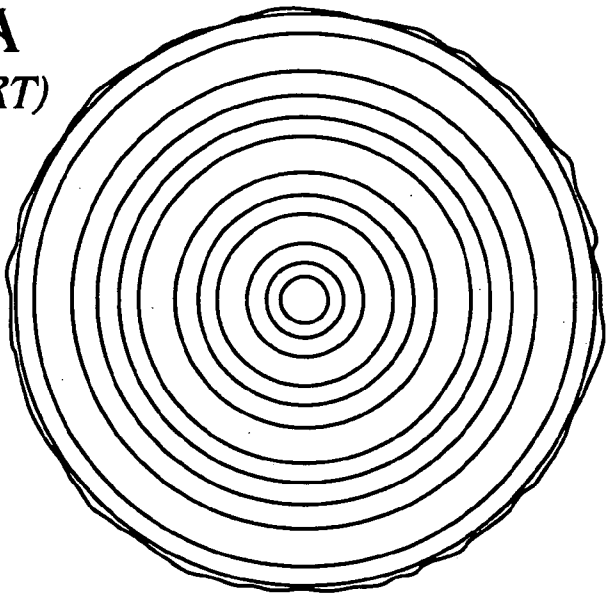


Fig. 2E
(PRIOR ART)

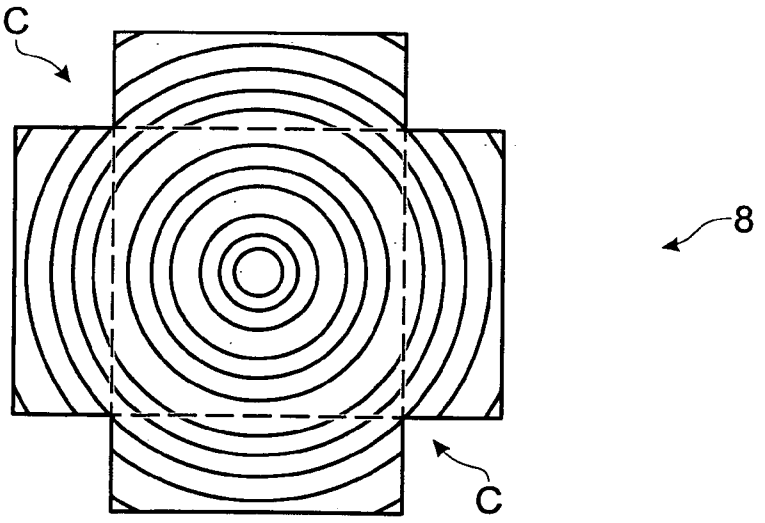
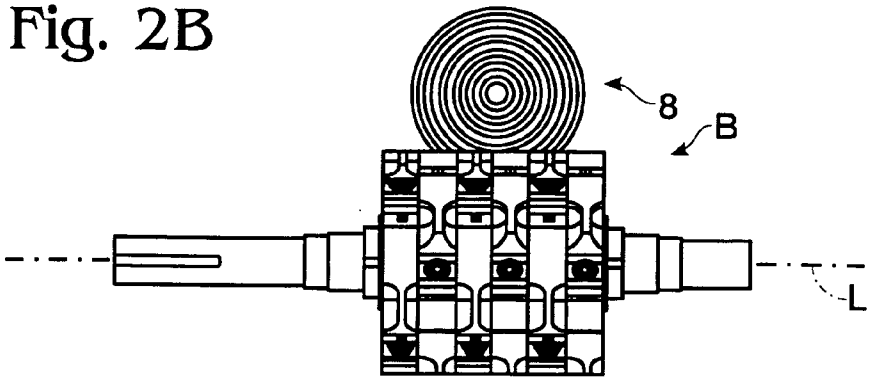
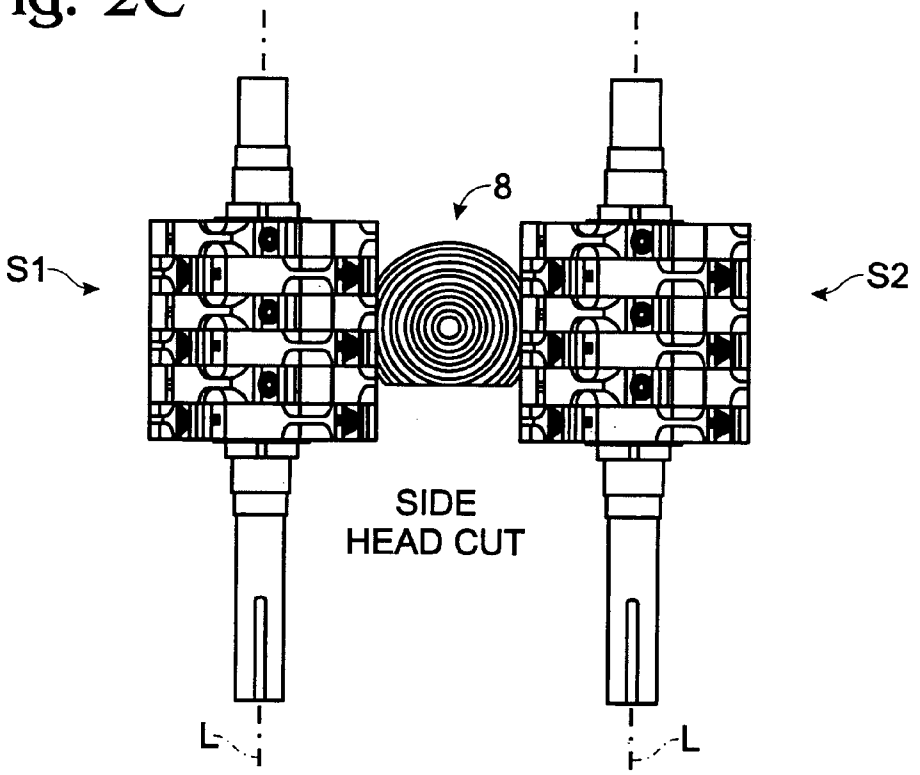


Fig. 2B



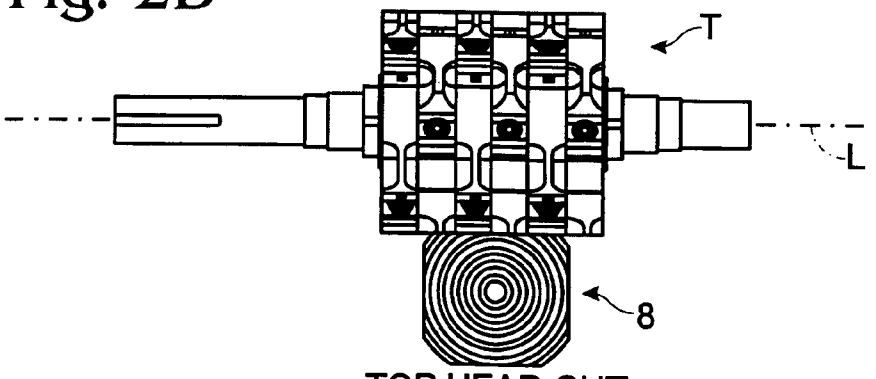
BOTTOM HEAD CUT

Fig. 2C



SIDE HEAD CUT

Fig. 2D



TOP HEAD CUT

Fig. 3
(PRIOR ART)

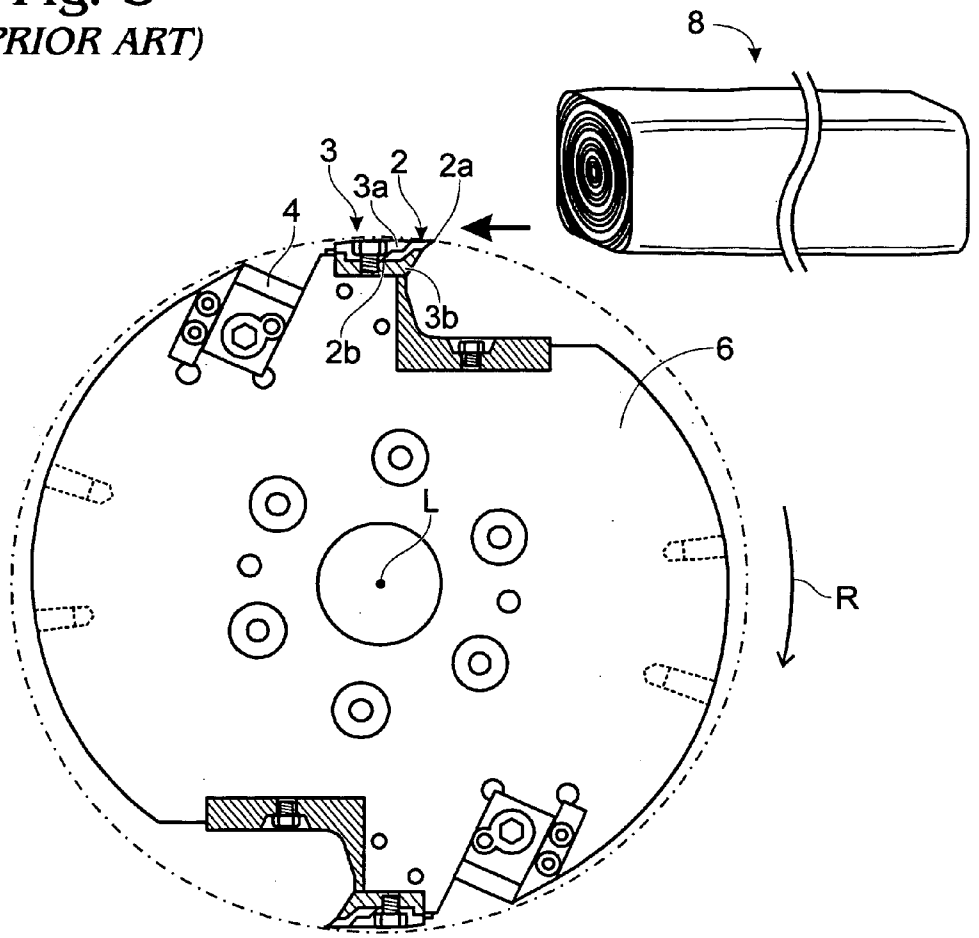


Fig. 4
(PRIOR ART)

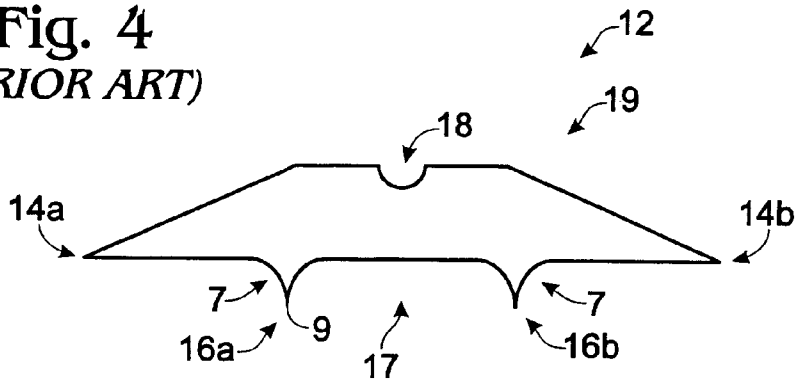


Fig. 5
(PRIOR ART)

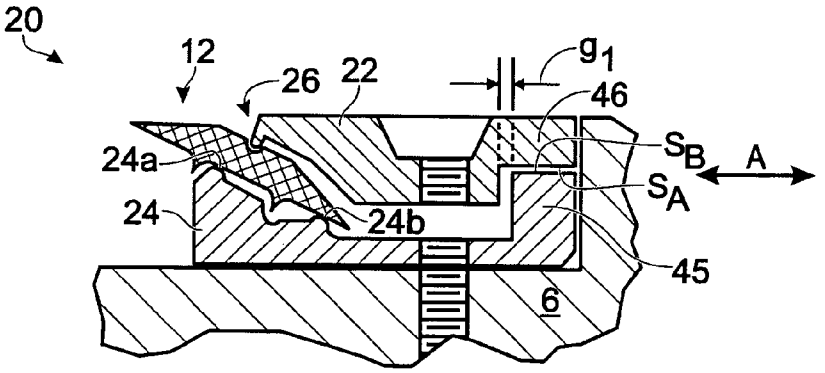


Fig. 6

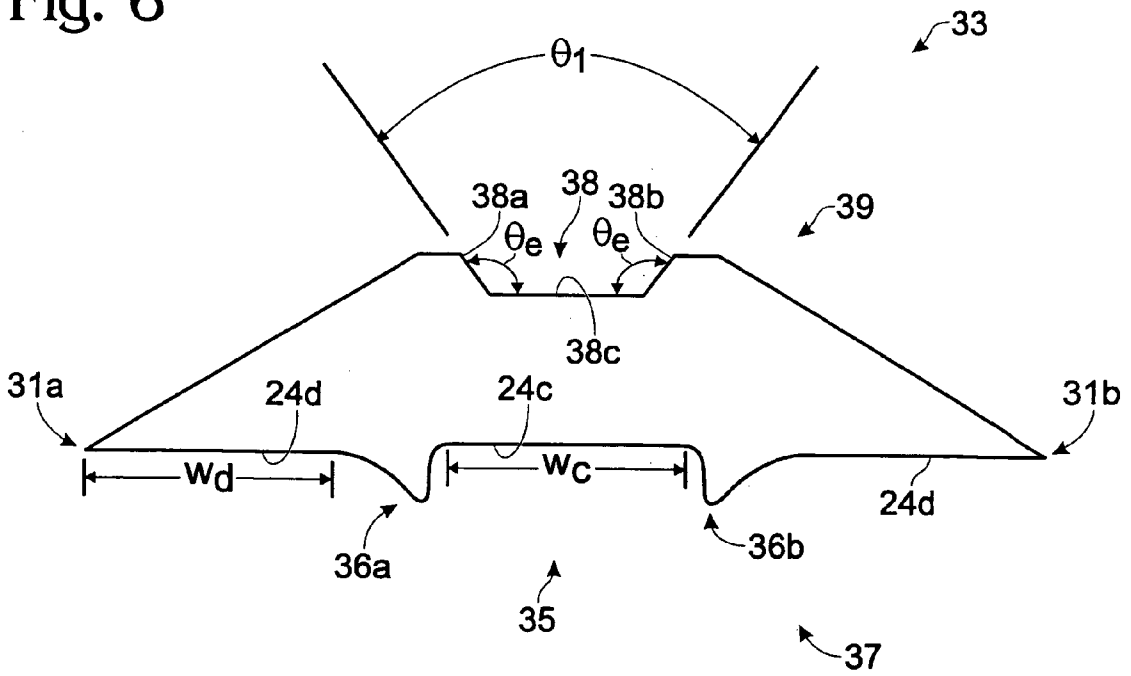


Fig. 7

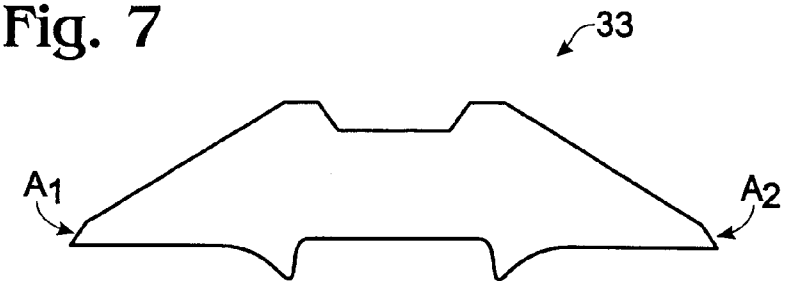
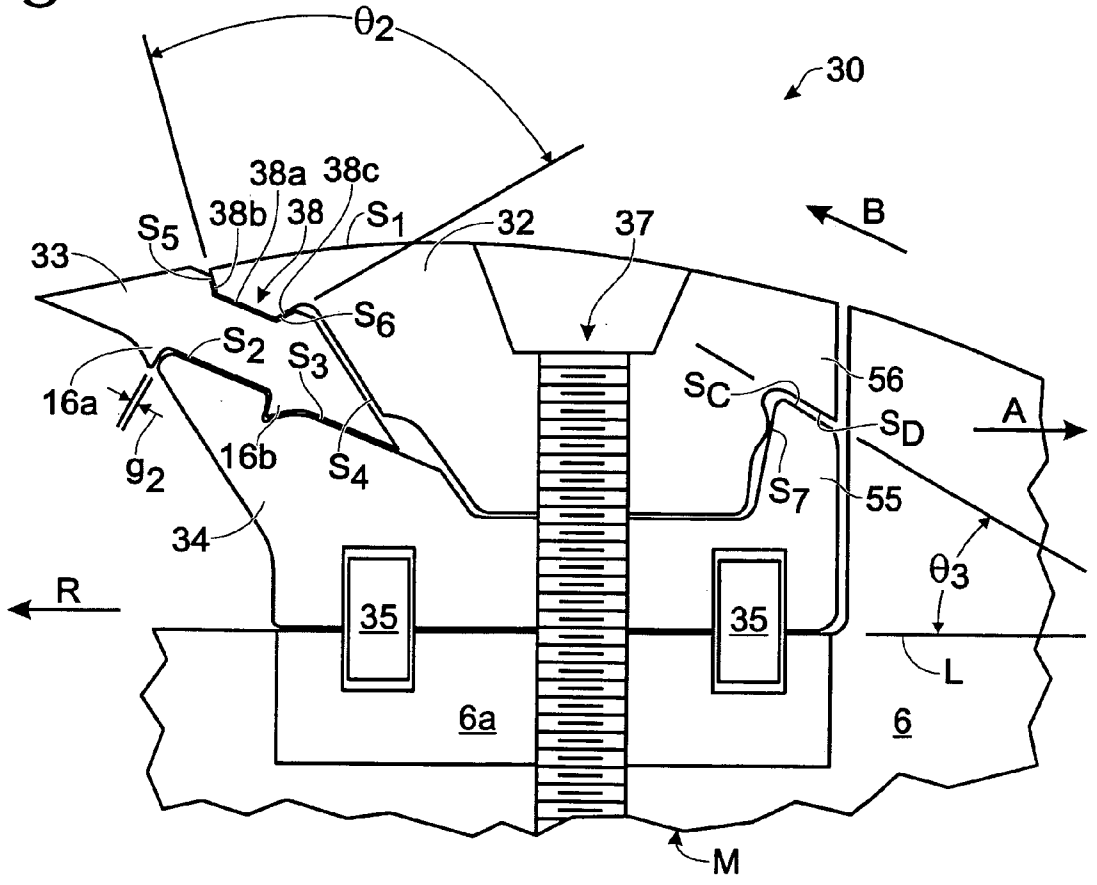

33
A1
A2

Fig. 8


θ2
30
38a
38c
38b
38
S1
32
37
B
S5
33
S6
S2
S3
16a
g2
16b
S4
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SC
56
SD
A
S7
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θ3
R
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35
L
6a
6
M

Fig. 9

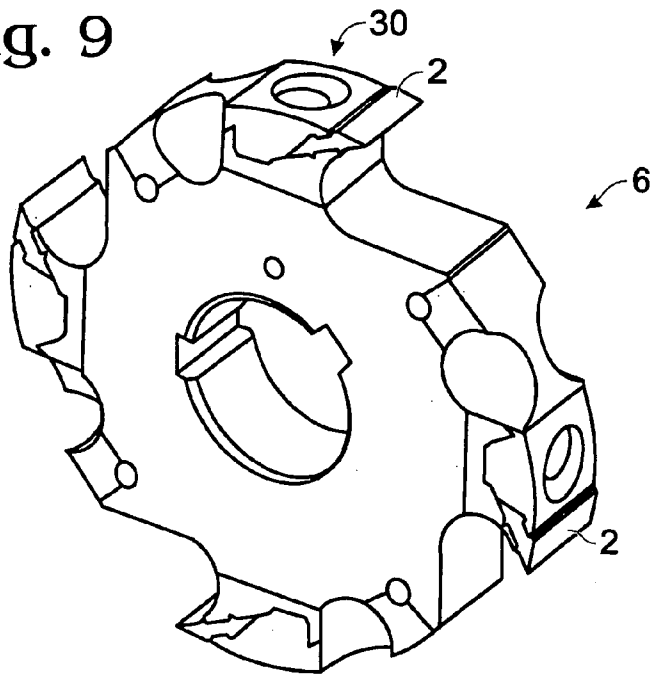


Fig. 10

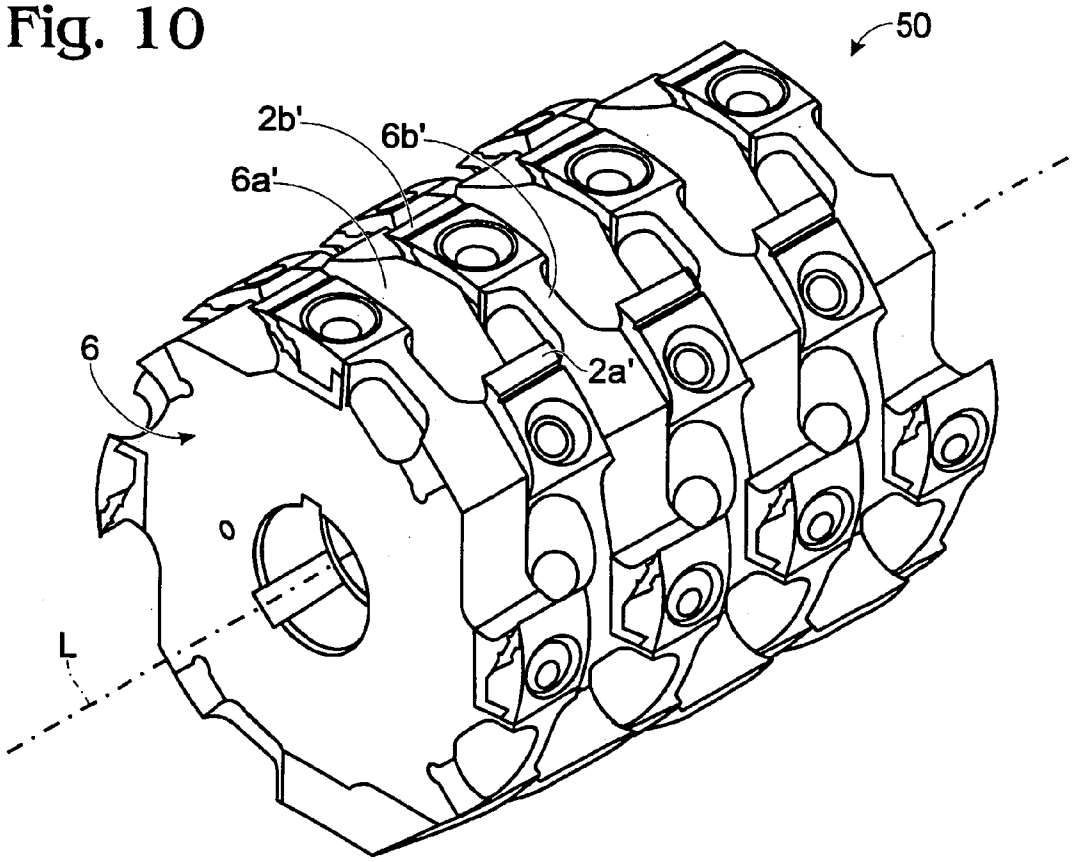


Fig. 11

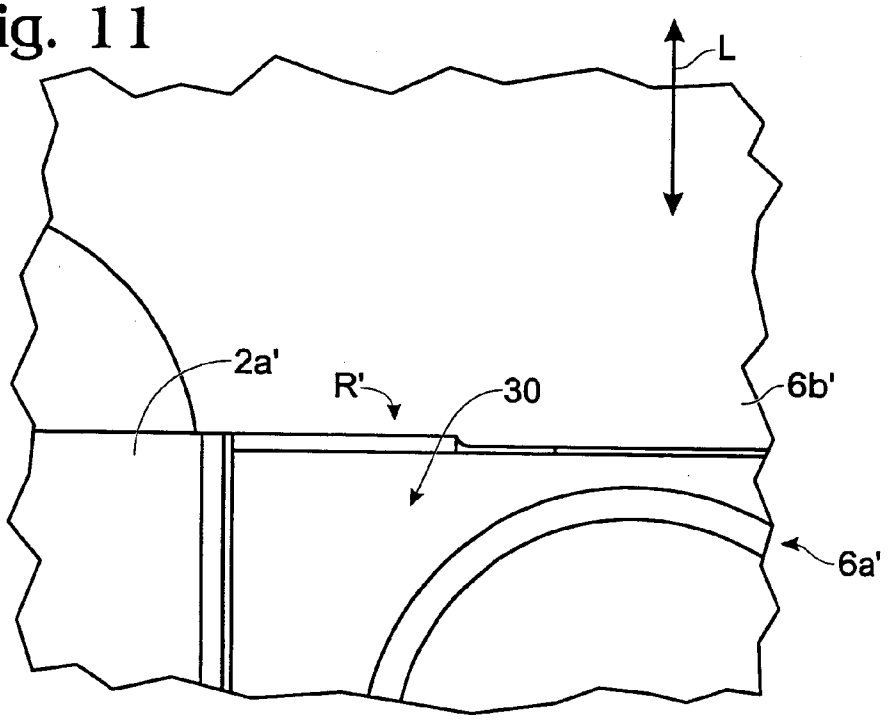


Fig. 12

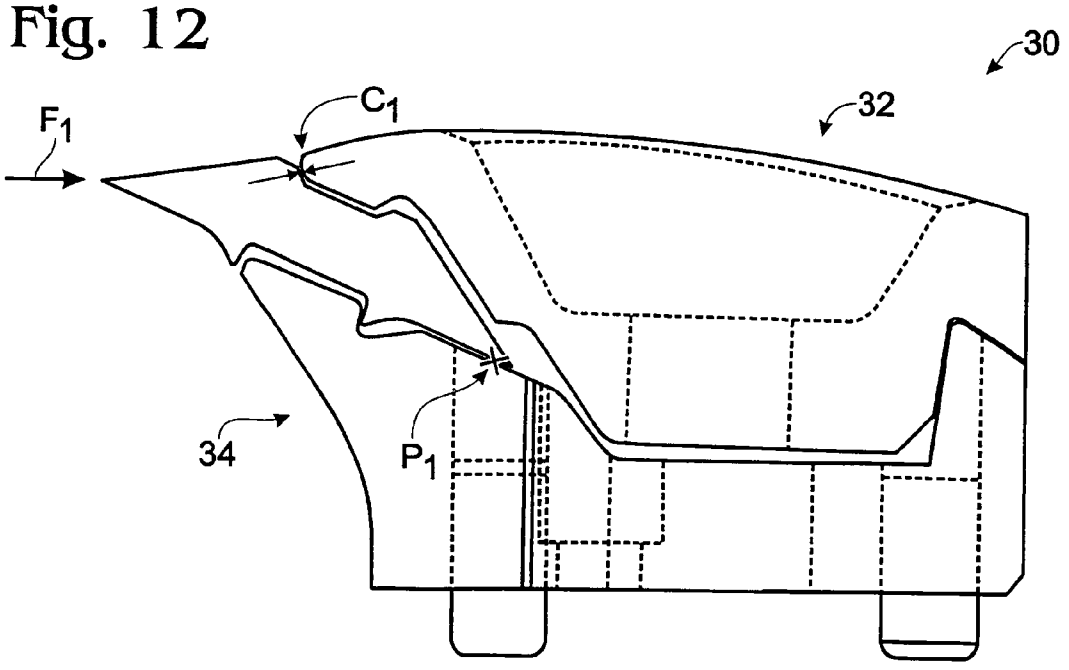


Fig. 13

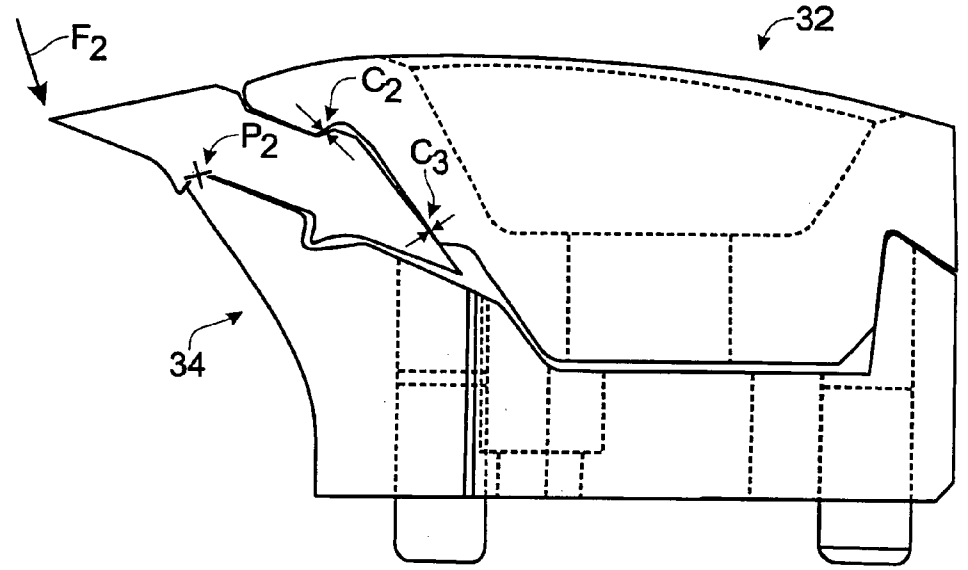


Fig. 14
(PRIOR ART)

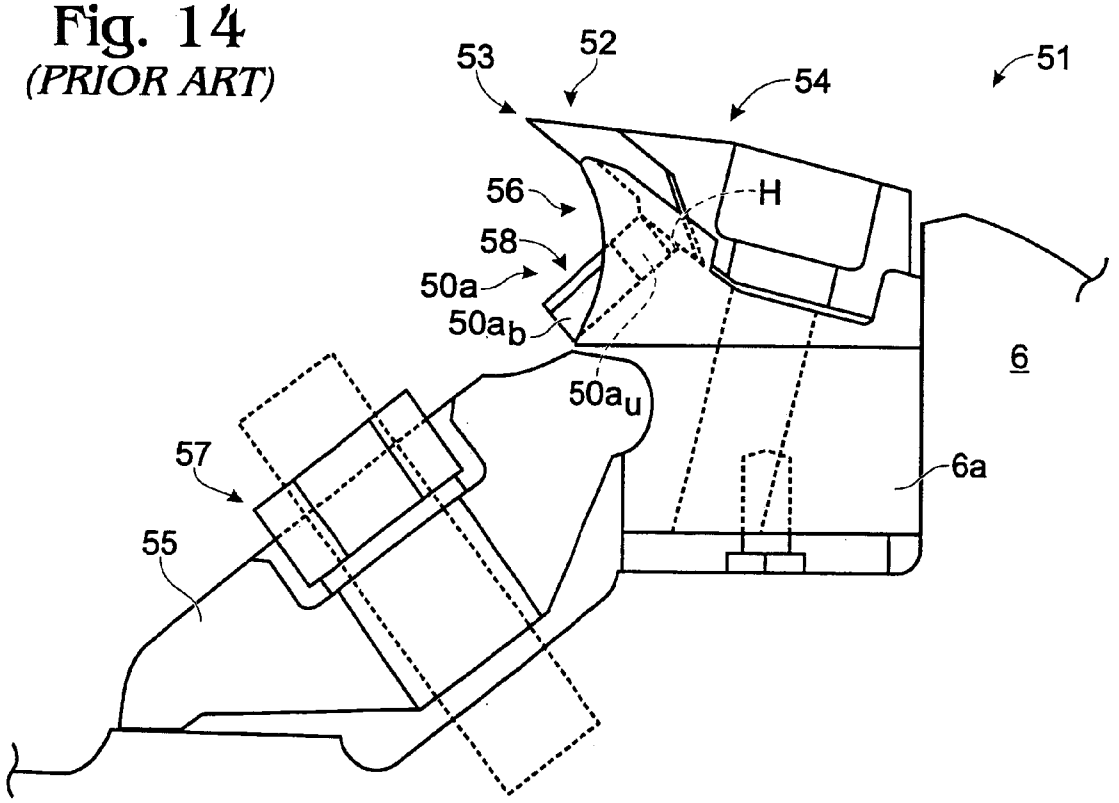


Fig. 16

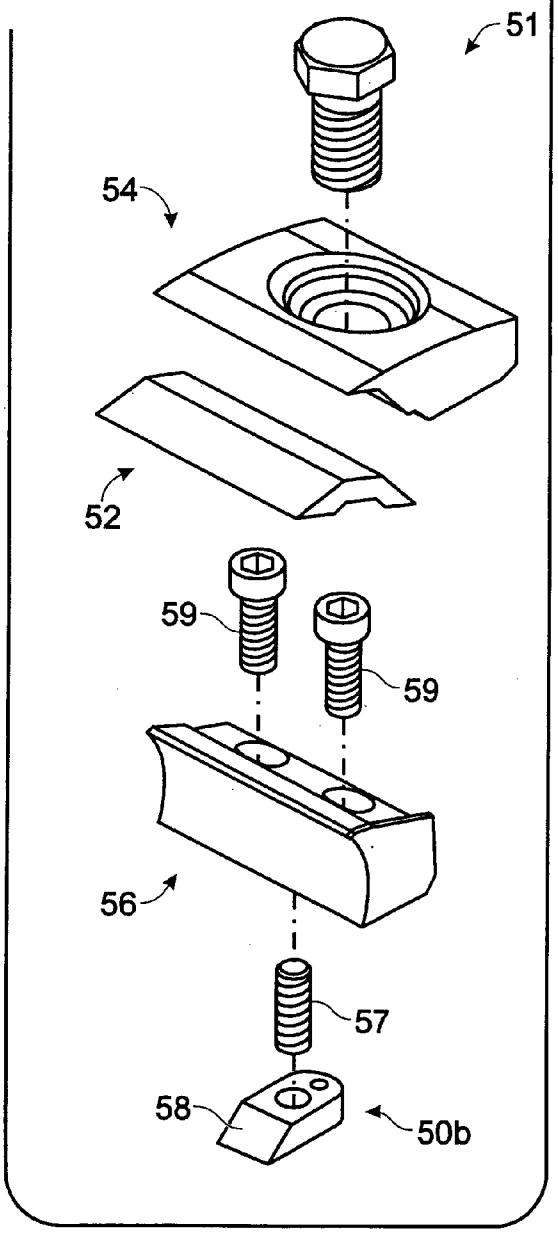


Fig. 15

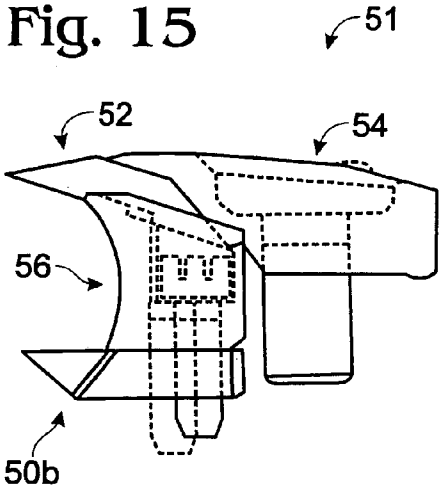


Fig. 21

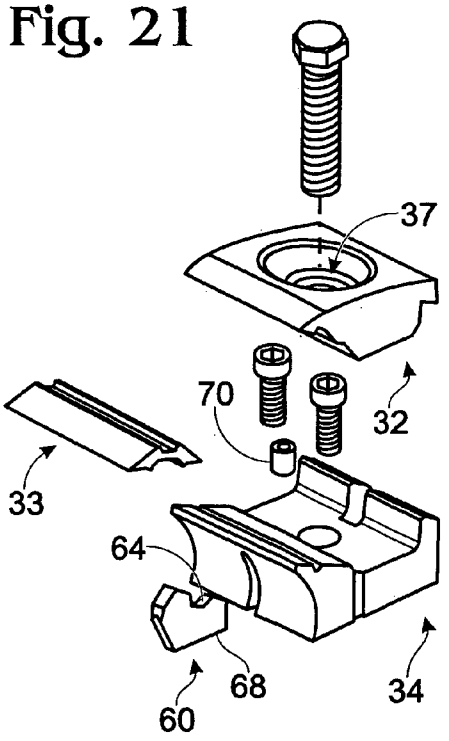


Fig. 17

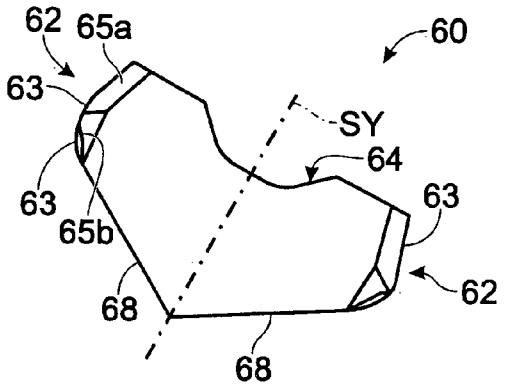


Fig. 19

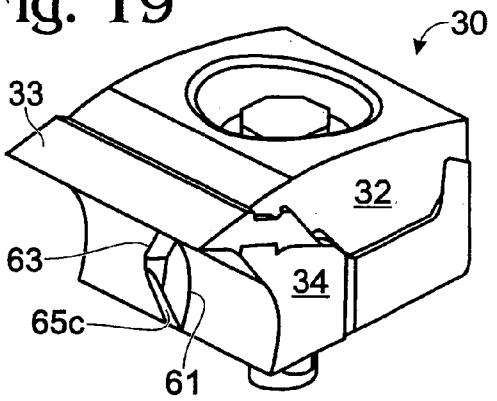
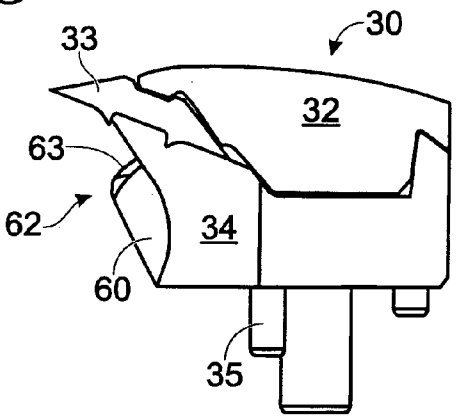


Fig. 18



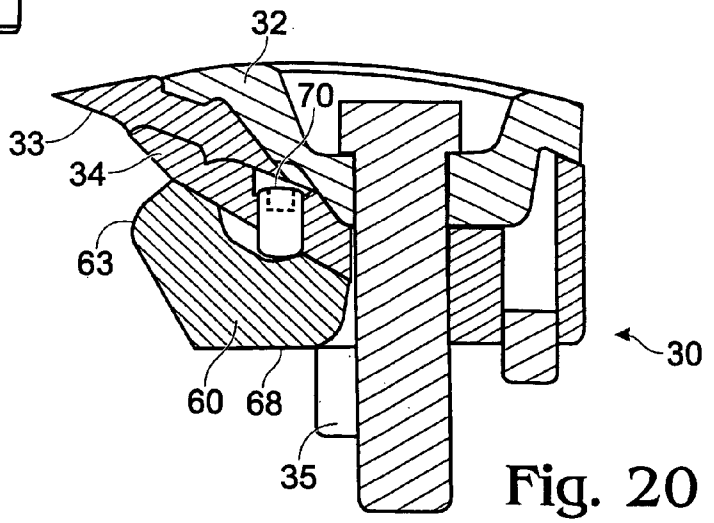


Fig. 20

WOOD CUTTING KNIFE ASSEMBLY PROVIDING IMPROVED KNIFE STABILITY

BACKGROUND OF THE INVENTION

The present invention relates to a wood cutting knife assembly providing improved knife stability, for use in wood processing.

Many kinds of wood cutting apparatus are used for processing logs, lumber, or wood refuse in a wood processing mill. For example, ring slicers, also termed ring flakers or stranders, are generally used for manufacturing particle board, oriented strand board, and fiberboard such as MDF. They convert logs, refuse lumber, chips, or other articles of wood into flakes, wafers or strands for the manufactured board products. Disc chippers are used to produce chips from waste wood, the chips also being used in manufactured wood products. Wood cutting apparatus having conical heads or drum style heads are used to produce squared lumber from logs.

All of these types of apparatus (hereinafter "wood cutting apparatus") employ removable knives that are exposed to large, highly episodic cutting forces over prolonged periods of time, yet the knives should be easily removable from the apparatus for maintenance, repair or replacement, and must be held in the apparatus in as stable a configuration as possible to produce high quality dimensioned lumber. It has proven difficult to meet all of these requirements.

A significant advance in the art of wood cutting knife assemblies is represented by Carpenter et al., U.S. Pat. No. 4,997,018, disclosing a knife assembly for use with the knife disclosed in Carpenter et al., U.S. Pat. No. 4,850,408. The knife is double-sided, i.e., has dual cutting edges, to provide a second, alternative cutting edge when the first cutting edge becomes worn or damaged. The knife includes a keyway for receiving a mating projection of a counterknife, the knife being clamped between the counterknife and an outer clamping member. The keyway and mating projection index the knife to the cutting apparatus to which the knife assembly is mounted, and positively secure the knife to the cutting apparatus.

More recently, Schmatjen, U.S. Pat. No. 5,819,826 discloses parallel ridges on the knife which straddle the projection of the counterknife. In addition to creating an effective keyway in the knife, the ridges deflect wood chips cut by the knife so as to reduce packing.

Bradstreet Jr. et al., U.S. Pat. No. 5,271,440, discloses a double-sided knife having a serrated surface for mating reception with a complementary serrated surface of, in this case, the outer clamping member. While apparently more difficult to manufacture than the aforementioned Carpenter et al. knife assembly, the assembly of Bradstreet Jr. et al. is like many in the prior art that are provided in recognition of the need to positively index and secure the knife to the cutting apparatus.

A further significant advance in the art of knife assemblies for use in wood cutting apparatus is represented in U.S. patent application Ser. No. 09/918,895 assigned to Key Knife Inc. The knife disclosed therein has deflector ridges on a front side of the knife to receive a mating projection of the counterknife in the manner of Schmatjen, U.S. Pat. No. 5,819,826, along with a recess in a back side of the knife to receive a mating projection from the outer clamping member of the clamping assembly. The counterknife is relieved and formed so that a definite "three-point" contact is made between the assembly and the knife comprising two points on the bottom surface of the knife and one point on the top surface of the knife. The two points of contact on the bottom surface of the knife are spaced as far apart as is practical, and the third point falls between these two points so that the knife is held in a stable configuration. Yet, the knife remains easy to remove from the assembly, and the complementary features provided in the outer clamping member and the knife actually improves the assembly in this regard.

So far as it is known, the prior art has not improved on this concept. However, the present inventors have recognized opportunities for further improving the stability of the knife in a knife assembly for use in wood cutting apparatus.

SUMMARY OF THE INVENTION

A wood chipping or cutting knife assembly providing improved knife stability according to a first aspect of the present invention provides a knife assembly for a wood cutting apparatus including a knife having a cutting edge and opposing front and back sides extending from the cutting edge, and an outer clamping member adapted to receive the back of side of the knife. The front side of the knife has a first interlocking feature and the back side of the knife has a second interlocking feature. The outer clamping member is adapted to receive the back side of the knife, and the outer clamping member has a third interlocking feature for interlocking with the second interlocking feature to index the knife to the outer clamping member. The second interlocking feature includes opposed first plane surfaces, and the third interlocking feature includes corresponding opposed second plane surfaces defining a second positive angle that is slightly greater than the first positive angle.

According to a second aspect of the invention, A knife for use in a knife assembly for a wood cutting apparatus is provided. The knife assembly includes a counterknife adapted for mounting to the apparatus and an outer clamping member adapted for mounting to the counterknife and for clamping the knife therebetween. The knife has an elongate axis and comprises two spaced apart cutting edges parallel to the elongate axis. The knife further includes opposing front and back sides extending between the cutting edges, the front side having a first interlocking feature for interlocking to the counterknife and the back side having a second interlocking feature for interlocking to the outer clamping member. The first interlocking feature includes a channel extending parallel to said elongate axis, and the second interlocking feature includes opposed spaced apart plane surfaces defining a positive angle therebetween.

According to a third aspect of the invention, a knife assembly for a wood cutting apparatus includes a knife and a counterknife. The knife has an elongate axis and comprises two spaced apart cutting edges parallel to the elongate axis. The knife further includes opposing front and back sides extending between the cutting edges, the front side having a pair of spaced apart deflector ridges extending parallel to the elongate axis and outwardly from the front side. The counterknife is adapted to receive the front side of the knife and to mount to the apparatus. The counterknife has an interlocking feature providing substantially full contact with the knife between the deflector ridges, to index the knife to the counterknife.

According to a fourth aspect of the invention, a knife assembly for clamping a knife to a rotating wood cutting apparatus is provided. The knife has a cutting edge and opposing front and back sides extending from the cutting edge. The knife assembly includes a counterknife adapted to receive the front side of the knife and to mount to the apparatus at a mounting point. The knife assembly further

includes an outer clamping member adapted to receive the back side of the knife and to mount to the counterknife. The counterknife includes a first heel portion, and the outer clamping member includes a second heel portion corresponding to the first heel portion. The first heel portion is adapted to oppose the second heel portion substantially along a line that is at a positive angle with respect to the direction of travel of the knife.

According to a fifth aspect of the invention, a knife assembly for a rotating wood cutting apparatus includes a knife, a counterknife, and an outer clamping member. The knife has a cutting edge and opposing front and back sides extending from the cutting edge. The counterknife is adapted to receive the front side of the knife and to mount to the apparatus at a mounting point and includes a first heel portion. The outer clamping member is adapted to receive the back side of the knife and to mount to the counterknife and includes a second heel portion corresponding to the first heel portion. The first heel portion is adapted to oppose the second heel portion substantially along a line that is at a positive angle with respect to the direction of travel of the knife.

According to a sixth aspect of the invention, a wood cutting apparatus is provided including a rotating member for rotating about an axis of rotation, a knife, an outer clamping member, and a counterknife. The knife has a cutting edge and opposing front and back sides extending from the cutting edge. The front side has a first interlocking feature and the back side having a second interlocking feature. The outer clamping member is adapted to receive the back side of the knife, the outer clamping member having a third interlocking feature for interlocking with the second interlocking feature to index the knife to the outer clamping member. The second interlocking feature includes opposed first plane surfaces defining a first positive angle therebetween, wherein the third interlocking feature includes corresponding opposed second plane surfaces defining a second positive angle that is slightly greater than the first positive angle. The outer clamping member is adapted to mount to the counterknife. The counterknife is adapted to receive the front side of the knife and to mount to the rotating member. The counterknife has a fourth interlocking feature for interlocking with the first interlocking feature to index the knife to the counterknife.

According to a seventh aspect of the invention, a wood cutting apparatus is provided including a rotating member for rotating about an axis of rotation, a knife, and a counterknife.

The knife has an elongate axis and comprises two spaced apart cutting edges parallel to the elongate axis, and has opposing front and back sides extending between the cutting edges. The front side has a pair of spaced apart deflector ridges extending parallel to the elongate axis and outwardly from the front side. The counterknife is adapted to receive the front side of the knife and to mount to the rotating member. The counterknife has an interlocking feature providing substantially full contact with the knife between the deflector ridges, to index the knife to the counterknife.

According to an eighth aspect of the invention, a wood cutting apparatus is provided including a rotating member for rotating about an axis of rotation, a knife, a counterknife, and an outer clamping member. The knife has a cutting edge and opposing front and back sides extending from the cutting edge. The counterknife is adapted to receive the front side of the knife and to mount to the rotating member at a mounting point and includes a first heel portion. The outer clamping member is adapted to receive the back side of the knife and to mount to the counterknife. The outer clamping member includes a second heel portion corresponding to the first heel portion. The first heel portion is adapted to oppose the second heel portion substantially along a line that is at a positive angle with respect to the direction of travel of the knife.

According to a ninth aspect of the invention, a wood cutting apparatus includes a rotating member for rotating about an axis of rotation, a knife having a cutting edge, a counterknife for mounting the knife to the rotating member, and a splitter. The counterknife has a way disposed below the cutting edge and accessible from outside the apparatus, and the splitter is adapted for manual insertion and removal through the way. In one embodiment, the splitter has at least one splitting portion including a curvilinear splitting edge for splitting articles of wood cut by the knife. In another embodiment, the splitter has two splitting edges substantially symmetrically disposed about an axis of said splitter.

A tenth aspect of the invention provides a splitter for a knife assembly for a wood cutting apparatus. The knife assembly includes a knife having a cutting edge and a counterknife for mounting the knife to the apparatus. The counterknife has a way, and the splitter is adapted to fit in the way. In one embodiment, the splitter comprises at least one curvilinear splitting edge adapted for splitting articles of wood cut by the knife. In another embodiment, the splitter comprises two substantially symmetrically disposed splitting edges adapted for splitting articles of wood cut by the knife.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side elevation of a typical cutting apparatus for cutting an article of wood.

FIG. **2**A is a cross-sectional view of a typical article of wood.

FIG. **2**B is a cross-sectional view of the article of wood of FIG. **2**A being cut by a bottom head of the cutting apparatus of FIG. **1**.

FIG. **2**C is a cross-sectional view of the article of wood of FIG. **2**A being cut by side heads of the cutting apparatus of FIG. **1**.

FIG. **2**D is a cross-sectional view of the article of wood of FIG. **2**A being cut by a top head of the cutting apparatus of FIG. **1**.

FIG. **2**E is a cross-sectional view of the article of wood of FIG. **2**A with a corner cut by the apparatus of FIG. **3**.

FIG. **3** is a plan view of a typical disc used in the apparatus of FIG. **1**.

FIG. **4** is a cross-sectional view of a prior art knife.

FIG. **5** is a cross-sectional view of a knife assembly for clamping the knife of FIG. **4** so as to provide "three-point contact" with the knife

FIG. **6** is a cross-sectional view of a knife according to the present invention.

FIG. **7** is a cross-sectional view of an alternative embodiment of a knife according to the present invention.

FIG. **8** is a cross-sectional view of a knife assembly according to the present invention including the knife of FIG. **6**.

FIG. **9** is a pictorial view of a single chipping or cutting disc with a knife assembly according to the present invention attached.

FIG. **10** is a pictorial view of a head assembly according to the present invention including a plurality of stacked discs of the type shown in FIG. **9**.

FIG. **11** is a plan view of a portion of the head assembly of FIG. **10**, showing interlocking of two adjacent disc segments.

FIG. **12** is a cross-sectional view of a knife assembly according to the present invention shown with a first applied cutting force vector and with reactions shown exaggerated.

FIG. **13** is a cross-sectional view of the knife assembly of FIG. **12** with a second applied cutting force vector and with reactions shown exaggerated.

FIG. **14** is a cross-sectional view of a knife assembly mounted to a chipping or cutting disc and incorporating a prior art "splitter."

FIG. **15** is a side elevation of a knife assembly incorporating an alternative embodiment of a prior art splitter.

FIG. **16** is an exploded view of the knife assembly and splitter combination of FIG. **15**.

FIG. **17** is a side view of a splitter according to the present invention.

FIG. **18** is a side elevation of a knife assembly according to the present invention incorporating the splitter of FIG. **17**.

FIG. **19** is a pictorial view of the knife assembly of FIG. **18**.

FIG. **20** is a side sectional view of the knife assembly of FIG. **18** with a lower portion of the counterknife removed.

FIG. **21** is an exploded view of a knife assembly according to the present invention incorporating a second embodiment of a splitter according to the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The present invention, directed generally to a wood cutting knife assembly providing improved knife stability, includes a number of aspects which are described separately for clarity. It is not essential to the invention to provide all aspects, or to provide any particular combination or subcombination of the aspects, the claims reciting the subject matter that the applicants regard as their invention.

For context, FIG. **1** shows a side elevation of a prior art wood cutting apparatus **11**. FIGS. **2**B–**2**D show the manner of cutting an article of wood **8** with the apparatus, here a log as shown in FIG. **2**A. Heads B, T, S**1** (FIG. **2**C) and S**2** rotate about respective axes of rotation "L." The bottom head B cuts a bottom side of the log, the top head T cuts a top side of the log, and side heads S**1** and S**2** cut corresponding sides of the log to square the log. It should be understood that the particular head geometry and construction shown is selected for illustration purposes only.

Turning to FIG. **3**, each head described above includes a plurality of stacked disc portions **6** (hereinafter "disc"), each disc supporting a plurality of knives **2**. The knives **2** are held in knife assemblies **3** comprising outer and inner clamping members **3***a* and **3***b*, respectively, where the inner clamping member is often referred to as a "counterknife." Cutting edges **2***a* of the knives **2** are exposed for cutting the wood **8**, the cutting edges extending along an axis that is perpendicular to the plane of the Figure. The knife assemblies are mounted to a rotating disc **6**. The disc **6** and therefore the knives **2** rotate about an axis of rotation "L" that is also perpendicular to the plane of the Figure in a direction of rotation "R." The double-sided knives **2** also include cutting edges **2***b* that are not exposed unless the knives are removed and turned end-for-end. Additional knives **4** may also be provided with cutting edges parallel to the plane of the Figure so that, together, the knives **2** and **4** may cut corners in the wood **8**. For example, if the article of wood **8** is a log as shown in FIGS. **2**A, the knives **2** and **4** may be used to cut the corner C, as shown in FIG. **2**E.

For comparison with the present invention, FIG. **4** shows a cross-sectional view of the prior art knife described in Schmatjen, U.S. Pat. No. 5,819,826 is shown. The knife is elongate with an elongate axis perpendicular to the plane of the Figure (not shown). The double-sided knife has two cutting edges **14***a*, **14***b*, two "deflector ridges" **16***a*, **16***b* on a front side **17** of the knife, and a semi-circular recess **18** on a back side **19** of the knife, which joins the front side **17** at the cutting edges **14***a* and **14***b*. The deflector ridges extend outwardly from the front side **17** and define a channel that provides an interlocking feature for interlocking with the counterknife.

This function could be provided by other structures, such as the keyway disclosed in U.S. Pat. No. 4,850,408. However, the deflector ridges also include concave curved outer surfaces **7** for deflecting wood chips from the counterknife, the outer surfaces **7** terminating in a line **9** which is seen as a point in the Figure.

Also for comparison with the present invention, FIG. **5** shows a cross-sectional view of a knife assembly **20** for attachment to a disc **6**, for clamping the knife **12** so as to provide "three-point contact" with the knife. The knife assembly **20** includes an outer clamping member **22** and an inner clamping member or counterknife **24**. The counterknife **24** includes two lands **24***a* and **24***b* for making contact with the front side **17** (FIG. **4**) of the knife **12**, and is otherwise relieved so that no other contact is made with the knife. The upper clamping member includes a projection **26** that is received by the recess **18** (FIG. **4**) of the knife, and is otherwise relieved so that no other contact is made with the knife.

The counterknife **24** includes a heel portion **45** that provides a backstop for a corresponding heel portion **46** of the outer clamping member **22**. The heel portions **45** and **46** are spaced apart by a tolerancing gap g_1 in a circumferential direction "A" that is substantially parallel to the circumferential surface of the disc **6** in the local area of the counterknife (shown flat in FIG. **5** as an approximation), and are otherwise slidingly disposed with respect to one another by virtue of the angle of the opposed surfaces S_A and S_B of the respective heel portions so that limited relative movement of the counterknife and outer clamping member is possible along this direction.

Now turning to FIG. **6**, a cross-sectional view of a knife **33** according to the present invention is shown. The knife is elongate with an elongate axis that is perpendicular to the plane of the Figure. The double-sided knife has two cutting edges **31***a*, **31***b*, and an interlocking feature **35** comprising two deflector ridges **36***a*, **36***b* on a front side **37** of the knife, and an interlocking feature **38** on a back side **39** of the knife, which joins the front side **37** at the cutting edges **31***a* and **31***b*. The interlocking feature **35** is adapted to mate with a corresponding feature in the counterknife, to index the knife to the counterknife, and the interlocking feature **38** is adapted to mate with a corresponding feature in the outer clamping member, to index the knife to the outer clamping member. The interlocking features may serve additional functions, as do the deflector ridges.

The interlocking feature **38** includes opposed planar surfaces **38***a* and **38***b* defining a positive (i.e., non-zero) included angle θ_1 reference to which is made below. The planar surfaces **38***a* and **38***b* are spaced apart by an intermediating planar surface **38***c* and make equal angles θe with

respect to the intermediating planar surface. FIG. **7** shows an alternative knife **33** having the same features that is "top ground" at A_1 and A_2.

Turning to FIG. **8**, a knife assembly **30** according to the present invention including the knife **33** is shown. The knife assembly **30** has an outer clamping member **32** with an outer surface S_1 tracing an arcuate line. The surface S is adapted to constrain the article of wood, as the knife assembly travels along its arc of rotation, by pressing on the freshly cut surface of the wood, to keep the article of wood from bucking the cutting apparatus. Such a shape for the surface S_1 is disclosed in the assignee's U.S. Pat. No. 6,164,352.

The knife assembly **30** further includes a counterknife **34** for cooperating with the outer clamping member **32** to clamp the knife. A bolt (not shown) extends through a bolt-hole **37** through both the outer clamping member and the counterknife into the disc **6**, or alternatively, into a block **6***a* in the disc (as shown). In addition, one or more pins **35** are preferably provided in corresponding receiving holes in the counterknife **34** and the disc **6** (or block **6***a*) to index the counterknife to the disc.

Contact with the knife **33** is controlled by five control surfaces S_2–S_7, shown exaggerated for purposes of illustration. The control surface S_2 is provided by the counterknife **34** between the deflector ridges **16** of the knife **33** and, unlike the land **24***a* (FIG. **5**), provides substantially "full contact" over the area there between. Particularly, referring to FIG. **6**, the knife has a surface **24***c* that has a width w_c, and the control surface S_2 makes full contact with the surface **24***c* over substantially the entire width w_c.

The control surface S_3 of the counterknife corresponds to the land **24***b* (FIG. **5**). Again referring to FIG. **6**, the knife has two surfaces **24***d* adjacent the respective deflector ridges, the surfaces **24***d* having widths w_d. Unlike the prior art knife's contact with the land **24***b* (FIG. **5**), the control surface S_3 makes contact with the unexposed surface **24***d* of the knife **33** as shown in FIG. **7** over a substantial area, e.g., at least 50% of the width w_d, rather than confining contact to a single point of contact. Preferably, the surfaces **24***c*, **24***d*, S_2 and S_3 are all planar; however, this is not essential.

The control surfaces S_4–S_7 are provided by the outer clamping member **32**. The control surface S_4 is a "stop" for movement of the knife in the circumferential direction "A." The control surfaces S_5 and S_6 act as wedges within the recess **38** of the knife **33**. Particularly, the control surfaces S_5 and S_6 bear against the side surfaces **38***b* and **38***c*, respectively, of the recess **38**. Wedging action is preferably provided by ensuring that the included angle θ_2 defined by the control surfaces S_5 and S_6 (FIG. **7**) is slightly greater than the corresponding angle θ_1 defined by the surfaces **38***b* and **38***c*. Exemplary values for θ_1 and θ_2, respectively, are 70 and 72 degrees, although the angles can range from about 50–90 degrees and the difference between the angles can range from about ¼ to 7 degrees, and more preferably about 1–4 degrees.

The remaining control surface S_7 engages the counterknife **34** to lock the counterknife to the outer clamping member and prevent movement of the outer clamping member with respect to the counterknife in the direction "A."

In addition to the control surfaces S_2–S_7, the invention may advantageously provide a gap "g" within the range of about 0.001" to 0.008", and more preferably about 0.005", between the counterknife **34** and the exposed deflector ridge, e.g., **16***a*. The gap is small enough to prevent significant loading of wood chip material, yet ensures that the load exerted on the knife **33** by the outer clamping member **32** is borne by the control surfaces S_2 and S_3.

The counterknife **34** includes a heel portion **55** and the outer clamping member **32** has a corresponding heel portion **56**. By contrast to the heel portions **45** and **46** of the prior art, the heel portions **55** and **56** of the present invention are not spaced apart by virtue of the contact between the counterknife and the outer clamping member at the control surface S_J. Opposed surfaces S_C and S_D of the heel portions are provided at an angle θ_3 according to the invention. The angle θ_3 is taken with respect to a line "L" that lies in the direction "R" of travel of the knife, which is typically the arc of rotation of the apparatus (the disc is drawn as though it has zero curvature in FIG. **8**) at the place of attachment of the assembly **30** thereto, i.e., at the mounting point "M." The angle θ_3 therefore defines the direction "B" shown. Relative movement of the outer clamping member **32** with respect to the counterknife in directions having angles less than θ_3 is prevented by the heel portions **55** and **56**. Preferably, the angle θ_3 ranges from about 20–40 degrees, and more preferably the angle is about 30 degrees.

The heel portion **55** provides a backstop for the corresponding heel portion **56**. Particularly, the control surface S_7 of the heel portion **56** abuts the heel portion **55** and thereby prevents movement of the outer clamping member **32**, with respect to the counterknife **34**, in the direction "A," which is opposite to the direction of rotation "R" of the disc.

FIG. **10** illustrates a further stabilizing aspect of the present invention. A number of discs **6** (see FIG. **9**) may be stacked as disc segments in a head assembly **50**. The disc segments **6** are angularly staggered with respect to the axis of rotation L so that the knives of adjacent disc segments, such as the knives **2***a*' and **2***b*' respectively of the disc segments **6***a*' and **6***b*', are not adjacent one another. Referring to FIG. **11**, the knives are slightly wider, in the direction of the axis L, than the disc segments, and the disc segments are relieved at R'slightly to receive overhanging portions of the knives of adjacent disc segments, so that the disc segments interlock with one another. Controlling the amount of this relief laterally constrains the knives and stabilizes their disposition in the disc segments.

FIGS. **12** and **13** illustrate, respectively, the assembly of FIG. **8** wherein the knife **33** is subject to two different force vectors F_1 and F_2. The forces F are applied by the log or lumber as it is cut or chipped. Movement of the knife in response to each of the forces F is controlled by the aforedescribed features. The knife pivots between the outer clamping member **32** and the counterknife **34** about pivot point P_1 in response to the force F_1 in FIG. **12**. The knife is restrained at C_1 at the surface **38***b* of the knife by the control surface S_5 (see FIG. **8**) of the outer clamping member. The knife also pivots about point P_2 in response to the force F_2 in FIG. **13** and is restrained at C_2 and C_3. The knife is restrained at C_2 at the surface **38***c* of the knife by the control surface S_6 (FIG. **8**) of the outer clamping member, and is restrained at C_3 at the outer surface **39** (FIG. **6**) of the knife by the control surface S_4 (FIG. **8**) of the outer clamping member.

Turning to FIG. **14**, a prior art "splitter" **50***a* is shown for use in a knife assembly **51** comprising a knife **52**, an outer clamping member **54** and a counterknife **56**. The splitter is disposed downstream of the knife and is used to split wood chips cut by the knife. FIG. **14** shows, in addition to a block **6***a* in the disc **6** for receiving the knife assembly **51**, a clamp **55** fastened to the disc **6** by a bolt **57** that engages the block **6***a*, a feature that may be employed in connection with the present invention as well. The splitter has a splitting edge **58** that is formed from a plate-like body portion $50a_b$ that fits into a cavity or way in the counterknife **56**, while an upper

portion **50***a*$_u$ of the splitter is cylindrical and fits in a hole "H" extending into the counterknife **56**. Replacing the splitter requires withdrawing the splitter through the hole "H" which is somewhat inconvenient. It is also recognized herein that the geometry of the splitter **50***a* and the splitting edge **58** are limiting in the range of positions and angles of the splitting edge **58** that can be made available with respect to the cutting edge **53** of the knife **52**, and that this lack of flexibility may result in a failure to achieve functionality.

Turning to FIGS. **15** and **16**, a second prior art splitter **50***b* is shown for use in the knife assembly **51**. In this embodiment, the splitter is mounted to the counterknife **56**, here between the counterknife and the disc **6** (or the block **6***a*). The splitter is held in place by clamping bolts **59** bearing on the counterknife **56**, and is located with a dowel pin **57**. It is recognized herein that the splitter **50***b* being disposed underneath the counterknife is inherently limited in positioning the splitting edge **58** in proximity to the cutting edge of the knife.

Turning now to FIGS. **17**–**20**, a splitter **60** according to the present invention is shown for use with the knife assembly **30** of FIG. **8**. The splitter is shown in FIG. **17**. It is shown attached to the counterknife in FIG. **19**, and with a lower portion of the counterknife removed in FIG. **20**.

The splitter **60** is received in a cavity or way **61** (FIG. **19**) in the counterknife via a non-interference fit, so that the splitter can be installed and removed from the counterknife, through the way **61**, by hand. The splitter has a beveled splitting portion **62** that projects outwardly from the counterknife **34** into the stream of wood chips cut by the knife **33** indicated by the arrow in FIG. **21**. The splitting portion **62** has a knife-like edge **63** resulting from beveling the splitter to create, preferably for ease of manufacturing, flat bevel portions **65***a* and **65***b* (FIG. **17**). The knife-like edge is preferably convexly curved such as shown. A flat bevel portion **65***c* forming an underside of the splitting portion **62** is shown in FIG. **19** may also be provided to provide support for the knife edge **63**.

Referring to FIG. **20**, the splitter **60** is held in the way **61** of the counterknife by a set-screw **70**. The set-screw is adapted to bear on a clamping surface **64** (FIG. **17**) of the splitter to hold the splitter in place. A bottom surface **68** of the splitter is adapted to rest on the disc **6** (or the block **6***a*) when the knife assembly **30** is mounted on the disc. The bottom surface **68** may include an aperture **66** for clearing the pin **35**, the pin **35** may be moved out of the way of the splitter as in FIG. **20** (where it is disposed behind the splitter with respect to the cross-sectional plane), or the splitter may terminate short of the pin **35** as in the embodiment shown in FIG. **21**.

The curvilinear splitting edge **63** provides increased control in locating the splitting edge at any desired position and angle with respect to the cutting edge of the knife. The splitter is also easily removable for repair or replacement by virtue of its being adapted to be removed and installed through the way **61**. In addition, the splitter is preferably bilaterally symmetric about an axis of symmetry "SY" as shown in FIG. **17** and in that form includes dual splitting portions **62** and corresponding knife-like edges **63**. This provides the outstanding advantage that, when the exposed splitting edge becomes dulled during use, the splitter can be easily removed from the counterknife **34** simply by loosening the set-screw **70**, removing the splitter from the knife assembly through the way **61**, rotating the splitter 180 degrees about the axis SY, and reinstalling the splitter in the counterknife **34** through the way **61** to provide a fresh splitting edge.

It is to be recognized that, while a specific wood chipping or cutting knife assembly providing improved knife stability has been shown and described as preferred, other configurations and methods could be utilized, in addition to configurations and methods already mentioned, without departing from the principles of the invention.

The terms and expressions which have been employed in the foregoing specification are used therein as terms of description and not of limitation, and there is no intention of the use of such terms and expressions to exclude equivalents of the features shown and described or portions thereof, it being recognized that the scope of the invention is defined and limited only by the claims which follow.

The invention claimed is:

1. A knife assembly for a wood cutting apparatus, comprising:

a knife having a cutting edge and opposing front and back sides extending from said cutting edge, said front side having a first interlocking feature and said back side having a second interlocking feature; and

an outer clamping member adapted to receive said back side of said knife, said outer clamping member having a third interlocking feature for interlocking with said second interlocking feature to index said knife to said outer clamping member, wherein said second interlocking feature includes opposed first plane surfaces defining a first positive angle therebetween, and said third interlocking feature includes corresponding opposed second plane surfaces defining a second positive angle that is slightly greater than said first positive angle, for wedging said outer clamping member in said second interlocking feature.

2. The knife assembly of claim **1**, further comprising a counterknife adapted to receive said front side of said knife and to mount to the apparatus, said counterknife having a fourth interlocking feature for interlocking with said first interlocking feature to index said knife to said counterknife, said outer clamping member adapted to mount to said counterknife.

3. The knife assembly of claim **2**, wherein the difference between said first positive angle and said second positive angle is in the range of about ¼–7 degrees.

4. The knife assembly of claim **2**, wherein said first angle is about 70 degrees.

5. The knife assembly of claim **4**, wherein said second angle is about 72 degrees.

6. The knife assembly of claim **1**, wherein the difference between said first positive angle and said second positive angle is in the range of about ¼–7 degrees.

7. The knife assembly of claim **1**, wherein said first angle is about 70 degrees.

8. The knife assembly of claim **7**, wherein said second angle is about 72 degrees.

9. The knife assembly of claim **1**, wherein said opposed first plane surfaces are spaced apart by an intermediating plane surface, said first plane surfaces defining a first positive angle therebetween, said first plane surfaces defining respective equal angles with respect to said intermediating plane surface.

10. The knife assembly of claim **9**, wherein the difference between said first positive angle and said second positive angle is in the range of about ¼–7 degrees.

11. The knife assembly of claim **9**, wherein said first angle is about 70 degrees.

12. The knife assembly of claim **11**, wherein said second angle is about 72 degrees.

13. A knife assembly for a wood cutting apparatus, comprising:

a knife having an elongate axis and comprising two spaced apart cutting edges parallel to said elongate axis and opposing front and back sides extending between said cutting edges, said front side having a pair of spaced apart deflector ridges extending parallel to said elongate axis and outwardly from said front side;

a counterknife adapted to receive said front side of said knife, said counterknife having an interlocking feature providing for contact with said knife between said deflector ridges, to index said knife to said counterknife, said knife including respective planar surfaces adjacent each of said deflector ridges extending out to the corresponding cutting edges, wherein said counterknife includes a planar surface adapted to make contact with a selected one of said planar surfaces of said knife; and

an outer clamping member adapted to receive said back side of said knife, said outer clamping member having an interlocking feature for interlocking with a corresponding interlocking feature of said back side of said knife to index said knife to said outer clamping member so that, in cooperation with said contact, a small gap exists between an exposed one of said deflector ridges and said counterknife, said gap ranging from about 0.001"–0.008".

14. A wood cutting apparatus, comprising:

a rotating member for rotating about an axis of rotation;

a knife having a cutting edge and opposing front and back sides extending from said cutting edge, said front side having a first interlocking feature and said back side having a second interlocking feature;

an outer clamping member adapted to receive said back side of said knife, said outer clamping member having a third interlocking feature for interlocking with said second interlocking feature to index said knife to said outer clamping member, and said second interlocking feature includes opposed first plane surfaces defining a first positive angle therebetween, wherein said third interlocking feature includes corresponding opposed second plane surfaces defining a second positive angle that is slightly greater than said first positive angle, for wedging said outer clamping member in said second interlocking feature; and

a counterknife adapted to receive said front side of said knife and to mount to said rotating member, said counterknife having a fourth interlocking feature for interlocking with said first interlocking feature to index said knife to said counterknife, said outer clamping member adapted to mount to said counterknife.

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